Ohio Operations Incident

Hannibal, OH

Environmental Sampling and Analysis Plan

Version 1.7

Prepared On Behalf Of:

Statoil

Prepared By:

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1.0 INTRODUCTION AND PURPOSE

This Sampling and Analysis Plan (SAP) was prepared on behalf of Statoil supporting Incident Command to provide environmental sampling work plans related to the Ohio Operations Incident in Hannibal, OH, which began on Saturday June 28, 2014. A map of the site location is provided in Attachment A.

The incident involves a well pad that was engulfed in a fire, consuming products that were stored on-site as well as releasing produced water from a wellhead. The objectives of the environmental investigation and proposed sampling include:

1) The collection of water, soil, and sediment samples to coarsely delineate areas of potential impact and assess the need for and, effectiveness of, the containment and cleanup activities on the well pad and areas potentially impacted from off-pad run-off.

2) The collection of background surface water, soil, and sediment samples to develop the range of potential background concentrations for comparative purposes and attempt to distinguish between target analytes related to this incident and non-related target analytes.

2.0 HEALTH AND SAFETY

CTEH® sampling personnel will review and adhere to the site specific Health and Safety Plan (HASP) developed by CTEH®. Sampling activities will only be completed in a safe manner and under safe conditions as dictated by the HASP.

3.0 DATA QUALITY OBJECTIVES

The data collected during field activities will be used to assess potential exposures to human health and the environment to constituents potentially related to the Ohio Operations Incident. A strategic planning approach will be employed for data collection activities providing a systematic procedure to ensure the type, quantity and quality of data used in decision-making will be appropriate for the intended application. All samples will be submitted to an analytical laboratory for a Level II data quality package.

4.0 SURFACE WATER AND SEDIMENT EVALUATION AND METHODOLOGY

4.1 Surface Water Monitoring

Surrounding drainage pathways and waterways downstream of the incident location will be visually inspected and photo-documented to note adverse impacts, if any. Documentation produced will also note general conditions such as GPS coordinates, odors, water flow,

weather, observations of any dead fish, etc. General water quality readings will also be documented along waterways both up gradient and down gradient of the well pad to monitor for potentially measurable impacts. Surface water monitoring will be conducted daily and will include the following parameters:

- Temperature
- pH
- Conductivity
- Dissolved Oxygen
- Turbidity
- ORP
- Salinity
- Total Dissolved Solids

4.2 Surface Water Samples

A surface water samples to be collected from run-off flowing off-pad prior to the well shut-in in an effort to characterize source constituents. Containment measures to be deployed and the impacted well has been shut-in. The site is currently being monitored to determine if run-off is escaping containment or impacting local waterways; if either case is found, a sample will be collected upstream and downstream of the run-off's confluence with the potentially impacted waterway. Additional surface water samples may be collected downstream from the site. A sample location map is included in Attachment A. All sampling will be documented in field notebooks, CTEH® field forms, or hand-held devices and surface water samples will be submitted to an Ohio certified lab for analysis.

Methodology and Analysis

Surface water samples will be carefully decanted directly into laboratory supplied sample containers and submitted to Pace Analytical, a NELAP-accredited laboratory, in Pittsburgh, Pennsylvania. Water quality parameters including: pH, ORP, dissolved oxygen, conductivity, salinity, TDS, temperature, and turbidity will be recorded for each surface water sample using a Horiba U-52 (or similar) water quality meter.

CTEH® plans on submitting collected samples for analysis of:

- Volatile organic compounds (VOCs) + TICS by USEPA Method 8260
- Semi-volatile organic compounds (SVOCs) + TICS by USEPA Method 8270
- Total Petroleum Hydrocarbons – Diesel Range Organics by USEPA Method 8015
- Cations by USEPA Method 6010B
- Anions by USEPA Method SM4500
- Ethylene Glycol by USEPA Method 8015

Acute aquatic toxicity tests indicate an LC_{50} for tributyl tetradecyl phosphoium chloride (TTPC) of <1 mg/L in certain fish species. At this time, no USEPA Method exists for the analysis of TTPC, a compound which comprises up to 10% (w/w) of the biocide BE-9 present on-site. Efforts are currently being undertaken to explore the potential for analytical method development for TTPC and, if available, will be presented to the Environmental Unit Leader for discussion.

Location and Frequency

Initial sampling consisted of the collection of surface water samples from the potentially impacted run-off liquids flowing off of the incident site. In addition to single-event surface water samples, i.e. locations sampled at one point in time only (site run-off and/or feeding tributaries), additional samples will be collected daily from established surface water sampling locations provided there is water flow in the area. A table identifying the frequency of sampling at each station, along with a map identifying the location of each station is provided in Attachment A. Surface water sampling will continue until Unified Command deems further daily sampling unnecessary following assessment of analytical sampling results.

Additional daily surface water sampling may consist of additional samples collected from the following locations as deemed necessary by Unified Command:

- Within the confluence of the Ohio River and Opossum Creek.
- Within the Ohio River, immediately upstream of the confluence of the Ohio River and Opossum Creek.
- Within the Ohio River, immediately downstream of the confluence of the Ohio River and Opossum Creek.
- Within the Ohio River along the West Virginia shoreline, directly across from the confluence of the Ohio River and Opossum Creek.

Surface water samples will be collected for at least 7 days following the start of the incident, at which point laboratory data will be reviewed and sampling plans will be re-assessed.

4.3 Sediment Samples

Sediment samples will be collected from the creeks, streams and river that are down gradient from the Site in order to characterize the surface and subsurface soil for the presence of constituents of concern (COPC).

Methodology and Analysis

The following procedures will be implemented for sediment samples in the waterways down gradient of the site. The planned sample locations coincide with surface water locations and are indicated on the map attached in Attachment A. Sediment samples will be per the following:

1. Sediment samples from each location will be collected utilizing a stainless steel spoon, or a modified Van Veen-type, self-tripping ponar sampling device (ponar). The overlaying water in the spoon or ponar sampling device will be carefully decanted off. Each sample container will be completely filled to minimize headspace. Vegetation, rocks, litter, and other non-native soil material will be carefully removed.
2. Non-disposable equipment will be decontaminated using a bristled brush and a solution comprised of a laboratory grade, non-phosphate detergent (e.g., Alconox or Liquinox), rinsed with distilled water, and then rinsed a second time with deionized water.
3. The following field notes will be collected for each soil sample:
    a. Observations regarding color, odor, etc.
    b. GPS coordinates of sampling points
    c. Photo-documentation of sample area
    d. Date and time
4. Sample containers will be clearly labeled with the following information:
    e. Unique sample identification
    f. Sampler initials
    g. Date and time sample collected
5. Field samples will be contained in accordance with appropriate USEPA specifications consistent with the intended analysis.
6. Evidence of collection, shipment, laboratory receipt, and laboratory custody will be documented by maintaining a chain of custody (COC) that records each sample and the individuals responsible for sample collection. All samples will be accompanied by a COC Record.

CTEH® plans on submitting collected samples for analysis of:

- Volatile organic compounds (VOCs) + TICS by USEPA Method 8260
- Semi-volatile organic compounds (SVOCs) + TICS by USEPA Method 8270
- Total Petroleum Hydrocarbons – Diesel Range Organics by USEPA Method 8015
- Chlorides
- Cations by USEPA Method 6010B
- Anions by USEPA Method SM4500
- Ethylene Glycol by USEPA Method 8015

Location and Frequency

Sediment samples will be collected from the waterways in conjunction with the surface water locations. Sediment samples will be collected as a onetime event. Upon review of the analytical results, additional samples may be collected after a significant rainfall event.

5.0 SOIL SAMPLING METHODOLOGY AND ANALYSIS

5.1 On-Pad Soil Samples

Soil samples will be collected from the production pad area in order to characterize the surface and subsurface soil for the presence of constituents of concern (COPC).

Methodology and Analysis

The following procedures will be implemented for soil sampling in the designated areas on-pad. The planned sample locations are indicated on the map attached as Attachment A. Soil samples will be collected from the ground surface to a depth of approximately 10'.

1. Soil samples from each location will be collected utilizing a stainless steel spoon or disposable sampling equipment. Each sample container will be completely filled to minimize headspace. Vegetation, rocks, litter, and other non-native soil material will be carefully removed.
2. Non-disposable equipment will be decontaminated using a bristled brush and a solution comprised of a laboratory grade, non-phosphate detergent (e.g., Alconox or Liquinox), rinsed with distilled water, and then rinsed a second time with deionized water.
3. The following field notes will be collected for each soil sample:
    a. Observations regarding color, odor, etc.
    b. GPS coordinates of sampling points
    h. Photo-documentation of sample area
    i. Date and time
4. Sample containers will be clearly labeled with the following information:
    j. Unique sample identification
    k. Sampler initials
    l. Date and time sample collected
5. Field samples will be contained in accordance with appropriate USEPA specifications consistent with the intended analysis.
6. Evidence of collection, shipment, laboratory receipt, and laboratory custody will be documented by maintaining a chain of custody (COC) that records each sample and the individuals responsible for sample collection. All samples will be accompanied by a COC Record.

CTEH® plans on submitting collected samples for analysis of:

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- Total Petroleum Hydrocarbons – Diesel Range Organics by USEPA Method 8015
- Chlorides
- Cations by USEPA Method 6010B
- Anions by USEPA Method SM4500
- Ethylene Glycol by USEPA Method 8015

Location and Frequency

Initial soil samples will be collected from the production pad area once the area has been cleared by IC for sampling activities. Additional samples may be required once data has been received and reviewed by IC.

5.2 Off-Pad Soil Samples

Off-pad soil samples will be collected from preferential run-off pathways from the production pad and select stream sampling locations in conjunction with surface water sampling locations.

Methodology and Analysis

The following procedures will be implemented for off-pad soil in the designated areas. Off-pad soil samples will be collected from preferential run-off pathways from the production pad and will be initiated after a near-pad survey has been conducted.

1. Soil samples from each location will be collected utilizing a stainless steel spoon or disposable sampling equipment. Each sample container will be completely filled to minimize headspace. Vegetation, rocks, litter, and other non-native soil material will be carefully removed.
2. Non-disposable equipment will be decontaminated using a bristled brush and a solution comprised of a laboratory grade, non-phosphate detergent (e.g., Alconox or Liquinox), rinsed with distilled water, and then rinsed a second time with deionized water.
3. The following field notes will be collected for each soil sample:
    A. Observations regarding color, odor, etc.
    B. GPS coordinates of sampling points
    C. Photo-documentation of sample area
    D. Date and time
    E. Sample containers will be clearly labeled with the following information:
        a. Unique sample identification

b. Sampler initials
c. Date and time sample collected

F. Field samples will be contained in accordance with appropriate USEPA specifications consistent with the intended analysis.

G. Evidence of collection, shipment, laboratory receipt, and laboratory custody will be documented by maintaining a chain of custody (COC) that records each sample and the individuals responsible for sample collection. All samples will be accompanied by a COC Record.

CTEH® plans on submitting collected samples for analysis of:

- Volatile organic compounds (VOCs) + TICS by USEPA Method 8260
- Semi-volatile organic compounds (SVOCs) + TICS by USEPA Method 8270
- Total Petroleum Hydrocarbons – Diesel Range Organics by USEPA Method 8015
- Chlorides
- Cations by USEPA Method 6010B
- Anions by USEPA Method SM4500
- Ethylene Glycol by USEPA Method 8015

Similar to the surface water sampling, efforts will be made to identify analytical methods to quantify the concentration of TTCP in off-pad soil.

Location and Frequency

Initial soil samples will be collected from the preferential run-off pathways from the production pad area and at designated stream locations. Additional samples may be required once data have been received and reviewed by IC.

5.3 Sub-surface Soil Sampling

Sub-surface soil samples will be collected from potentially impacted areas both on and off the StatOil Eisenbarth well pad. Samples will be collected through hand advanced direct push soil borings.

Methodology and Analysis

The following procedures will be implemented for on-pad and off-pad soil in the designated areas. Soil samples will be collected from potential preferential run-off pathways from the production pad or based on surface water flow direction and will be initiated after a near-pad survey has been conducted. Subsurface soil samples will be collected from locations depicted on the Soil Sampling Location map in Attachment A.

Utility Clearance

Prior to field mobilization for the activities described in this SAP, a utility mark-out will be performed to identify underground utilities at the Site. The utility mark-out will be made through the Ohio Utilities Protection Service (OUPS) – underground utilities search system at 8-1-1 or (800) 362-2764. In addition to the OUPS call, a review of available site drawings will be conducted to evaluate for the presence of site utilities not identified by the OUPS notification. If necessary, soil boring locations will be modified in the field to avoid potential interference from utilities.

Soil Boring Installation

Subsurface soil samples will be collected through the use of direct push Geoprobe System's - Large Bore soil sample barrel. These borings will be driven into the ground using either an electric jackhammer outfitted with the direct push equipment or Geoprobe Model 54LT direct push track mounted machine.

Soil borings will be advanced to the depth of equipment refusal or approximately 10' (with the jackhammer driven equipment) or approximately 30' (with the model 54LT track mounted unit), whichever is less.

Field work conducted during this investigation, including soil boring and sampling activities will be conducted in accordance with the Job Safety Analysis (JSA) and Work Permit.

Continuous soil cores will be collected within disposable acetate sleeves with the direct push equipment. Upon retrieval from the boring, the sleeves will be opened by the CTEH personnel for field screening with a PID, visual evaluation and sample collection. At a minimum, one soil sample will be collected from the level of where the highest PID reading was observed and another soil sample will collected from the bottom of the borehole.

Following completion of borings at a given location, including field screening and sampling activities, soil not used for sampling will be returned to the boring. Some borings may be left open and PVC well screen may be temporarily may be placed in the boring to keep the bore hole open to look for subsurface water infiltration.

Sample Collection

1. Soil samples from each location will be collected utilizing a stainless steel spoon or dedicated disposable sampling equipment. Each sample container will be completely filled to minimize headspace. Vegetation, rocks, litter, and other non-native soil material will be carefully removed.
2. Non-disposable equipment will be decontaminated using a bristled brush and a solution comprised of a laboratory grade, non-phosphate detergent (e.g., Alconox or Liquinox), rinsed with distilled water, and then rinsed a second time with deionized water.
3. The following field notes will be collected for each soil sample:
    i. Observations regarding color, odor, PID readings, etc.
    ii. Soil lithology and depth

iii. GPS coordinates of sampling points
iv. Photo-documentation of sample area
v. Date and time

4. Sample containers will be clearly labeled with the following information:
    b. Unique sample identification
    c. Sampler initials
    d. Date and time sample collected
5. Field samples will be contained in accordance with appropriate USEPA specifications consistent with the intended analysis.
6. Evidence of collection, shipment, laboratory receipt, and laboratory custody will be documented by maintaining a chain of custody (COC) that records each sample and the individuals responsible for sample collection. All samples will be accompanied by a COC Record.

CTEH® plans on submitting collected samples for analysis of:

- Volatile organic compounds (VOCs) + TICS by USEPA Method 8260
- Semi-volatile organic compounds (SVOCs) + TICS by USEPA Method 8270
- Total Petroleum Hydrocarbons – Diesel Range Organics by USEPA Method 8015
- Chlorides
- Cations by USEPA Method 6010B
- Anions by USEPA Method SM4500
- Ethylene Glycol by USEPA Method 8015

Similar to the surface water sampling, efforts will be made to identify analytical methods to quantify the concentration of TTCP in off-pad soil.

Location and Frequency

Initial subsurface soil samples will be collected in the area of the preferential run-off pathways or surface water runoff areas from the production pad area. Boring locations will also be selected along the western and southern slopes below the Eisenbarth pad. The hand probe will be used for the steep slope areas and the track mounted unit will be utilized on the flatter bench locations on the slopes. Once access is cleared, soil borings may be advanced at various locations on the Eisenbarth pad. Additional samples may be required based on field observations and/or once data have been received and reviewed by IC.

Upon completion of the borings, if any water or soil is found to be suspect, samples may be collected for analyses. Water and soil samples will be collected in accordance with Sections 4.0 and 5.2 above.

5.4 Soil Test Pits

In order to investigate any potential subsurface water or liquid migration from the production pad, test pits will be installed at various locations off the pad. The test pits will be installed through the use of a hydraulic mini-excavator. The test pits will be excavations to a depth of

approximately 3'-4' and a length of approximately 4' and a width of approximately 2'. The pits will be backfilled after visual observations and PID screening is completed.

Upon completing the excavation of each test pit, if any water or soil is found to be suspect, samples may be collected for analyses. Water and soil samples will be collected in accordance with Sections 4.0 and 5.2 above.

If warranted, the test pits may be extend and turned into trenches for recovery of water or liquids from either surface or sub-surface flow.

5.5 Surface Soil Screening

In an effort to assess any surface soil impact along the slopes down gradient from the well pad, field screening will be utilized. Soil samples will be collected across the slopes at approximately a 100' interval and placed in containers (either glass jars or ziplock bags). After approximately 15 minutes, the head space will be check for volatile organics through the use of a handheld photoionization detector (PID). Following the headspace analyses, the location will be labeled and marked with a Pin flag for further investigation if needed.

6.0 SAMPLE HANDLING PROCEDURES

Samples will be placed in laboratory supplied sample containers and labeled with a sample identification number, sample depth (for water column sampling), sampler name, sample date, analysis and methodology requested, and time of sample collection, and immediately placed in a cooler on ice pending laboratory analysis. Samples will be packaged, labeled, retained on ice, and documented in an area which is free of impact and provides for secure storage. Custody seals will be placed on each sample-containing cooler, and chain-of-custody procedures will be maintained from the time of sample collection until arrival at the laboratory to protect sample integrity. Shipping or transporting of samples to the laboratory will be done within a timeframe such that recommended holding times are met. Samples are being collected in adequate volumes in sample containers of a broad variety to ensure that any future requested analyses can be performed given the collected sample container types.

6.1 SAMPLE LABELING

Sample containers will be clearly labeled with the following information:

- Unique sample identification;
- Sample Type (discrete or composite, sediment and/or soil samples only);
- Sampler name or initials;
- Date sample collected;
- Time sample collected; and
- Analysis to be performed.

The unique sample designation will include the following: sample type, two digit day, two digit month, two letter matrix prefix, three-digit numerical designation, and QA sample designation, as appropriate. The sample type will be SW surface water and SC for source sampling.

Quality assurance samples include Matrix Spikes (MS - 1 in 20 by media), Matrix Spike Duplicates (MSD - 1 in 20 by media), rinsate blank (RB) only when using non-dedicated sampling equipment, and duplicates (DUP) in 1 out of 10 samples by media. These samples are defined further below.

7.0 QUALITY ASSURANCE

Sampling will be carried out in conjunction with a well-defined quality assurance (QA) program. The goal of the field QA program is to document that samples are collected without the effects of accidental cross- or systematic contamination and refers to the sampling, analysis, and data validation procedures for generating valid and defensible data. To provide QA for the proposed sampling event, the following sampling, analysis, and data validation procedures will be performed:

Field Calibration

Instruments used in the field as part of this sampling event are anticipated to consist of Horiba U-52 water quality meters, GPS units, digital cameras, and hand-held data collection devices such as tablets/smart phones. Horibas will be calibrated daily. Other equipment is not anticipated to require field calibration. Operators of each piece of equipment are responsible for maintaining (including proper battery charge) and operating this equipment such that it conforms to each respective manufacturer's specifications.

Field Duplicate Sample

For approximately every ten samples collected in the field, one field duplicate will be collected and submitted for laboratory analysis to verify the reproducibility of the sampling methods. Field duplicates will be prepared by separately submitting an aliquot from the same sample location to the laboratory for analysis consistent with the proscribed analyses.

Field Split Samples

Field split samples refer to samples collected by the on-site regulatory agency or its designee from the same sampling location and independently submitted to a different laboratory for analysis. Field split samples may be collected at the discretion of representatives of the regulatory agency or Incident Command.

Laboratory QA

Laboratory quality control procedures will be conducted in a manner consistent with relevant state and federal regulatory guidance. Deliverables will contain the supporting documentation necessary for data validation. Internal laboratory quality control checks will include method blanks, matrix spikes (and matrix spike duplicates), surrogate samples, calibration standards, and laboratory control standards (LCSs).

Matrix Spike/Matrix Spike Duplicate Sample

Matrix Spike/Matrix Spike Duplicate (MS/MSD) samples refer to field samples spiked with the analytes of interest prior to being analyzed at the laboratory to gauge the quality of analysis. Approximately one in twenty samples will be analyzed as MS/MSD samples.

Data Validation

Validation of the data generated by the laboratory performing the analyses will include at a minimum sample holding times, accuracy, precision, contamination of field generated or laboratory method blanks, and surrogate compound recovery. Accuracy will be determined by evaluating LCS and MS recovery. Precision will be determined by evaluating laboratory and field duplicate samples. Level II data validation will be performed on 100% of submitted samples. Level IV data validation will be performed on at least 10% of submitted samples.

8.0 DECONTAMINATION PROCEDURES

Decontamination procedures refer to the steps undertaken to minimize the potential for off-pad contamination and cross-contamination between individual sampling locations. Prior to collecting any sample for this investigation, the following decontamination procedures will be undertaken: non-disposable sampling equipment such as Kemmerer water sampling devices which come into contact with sampling media will be decontaminated using a bristled brush and a solution comprised of a laboratory grade, non-phosphate detergent (e.g., Alconox or Liquinox) and deionized water. Depending on ancillary activities being conducted for the response to this release, the decontamination of sampling equipment will be conducted over poly sheeting at the sample location or in a nearby designated area. The sampling equipment to be decontaminated will first be placed in a bucket containing the detergent solution and thoroughly washed using a bristled brush. The items will then be transferred to the second 5-gallon bucket containing deionized water for rinsing. Following the initial rinsing, the item will be held over the third 5-gallon bucket while deionized water is carefully decanted over each item. Decontaminated items will be wrapped in clean aluminum foil for transit to the next sampling location.

Nitrile gloves will be worn by sampling personnel and changed between activities at each discrete sample collection location. Previously worn nitrile gloves will be discarded in appropriate waste receptacles with other PPE.

9.0 WASTE DISPOSAL

The method for storage and disposal of investigative-derived waste materials will comply with applicable local, state, and federal regulations in a manner consistent with the Waste Management Plan (WMP). (This WMP is pending the decision of identification of the Waste Generator).

10.0 DATA ANALYSIS

To assess the potential environmental impact from the compromised well pad, the results of sampling will be reviewed for the presence/absence of on-site constituents. The concentrations of detected compounds will then be compared to appropriate regulatory standards. The results of laboratory analyses will be provided to IC.

11.0 RECORDS MANAGEMENT

Records management refers to the procedures for generating, controlling, and archiving project-specific records and records of field activities. Project records, particularly those that are anticipated to be used as evidentiary data, directly support current or ongoing technical studies and activities, and provide historical evidence needed for later reviews and analyses, will be legible, identifiable, retrievable and protected against damage, deterioration, or loss on a centralized electronic database. Handwritten records will be written in indelible ink. Records will likely include, but are not limited to, the following: bound field notebooks on pre-numbered pages, sample collection forms, personnel qualification and training forms, sample location maps, equipment maintenance and calibration forms, chain-of custody forms, maps and drawings, transportation and disposal documents, reports issued as a result of the work, procedures used, correspondences, and any deviations from the procedural records. Documentation errors will be corrected by drawing a single line through the error so it remains legible and will be initialed by the responsible individual, along with the date of change, and the correction will be written adjacent to the error.

Attachment A:

Frequency of Sampling Table
&
Analytical Sampling Map

Sample Location	Sampling Frequency
SW01	1x
SW02	1x
SW03	Daily
SW04	Daily
PW05	1x
SW06	Daily
SW07	Daily
SW08	Daily
SW09	Daily
SW10	Daily
SW11	1x
SW12	1x
SW13	1x
SW14	1x
SW15	1x
SW16	Daily
SW17	Daily
SW18	Daily
SW19	Daily
SW20	Daily
SW21	Daily